University of Alberta Library
0 1620 2122 2243

IOP
SCIENCE
GRADES 8 AND 9

A. PROGRAM RATIONALE AND PHILOSOPHY

RATIONALE

In recognition that the needs of both the individual and society may best be served through school experiences designed to meet student needs and abilities, the *Secondary Education in Alberta* policy statement, June 1985, directs that a program be developed for students who have experienced difficulty learning. This program, beginning in Grade 8, is known as the Integrated Occupational Program (IOP) and articulates with a similar program in the senior high school. The policy states that:

> . . . the goals of secondary schools are to assist students . . . to become aware of the expectations, and be prepared for the opportunities of the workplace—expectations that will be faced as employees or employers; expectations that will be faced as entrepreneurs or volunteers . . . (p. 13)

The policy also states the value of community partnerships in the educational process:

> Opportunities must be provided to involve the community in secondary education programs to recognize and support learning experiences which take place outside of schools. (p. 8)

Q
183.4
C22
A3
A33
1992
gr.8-9

CURR GD
HIST

tion, the policy statement directs that:

> e Certificate of Achievement will be arded to those students who, because of their abilities and needs, have taken the Integrated Occupational Program. The Certificate will recognize their achievement in that program. (p. 23)

The Integrated Occupational Program is designed to enable students to:

- become responsible members of society
- develop entry-level vocational abilities
- recognize the need for lifelong learning.

The Integrated Occupational Science Program, Grades 8 and 9, provides for the development of essential concepts, skills and attitudes in science that will enable students to function successfully in the home, classroom, workplace and community. The program is activity-based, and addresses the need for students to be able to transfer and apply specific scientific concepts and skills to more generalized situations in everyday life and the world of work. This approach is intended to foster an appreciation of science for its usefulness and relevance, and thus motivate students to participate in the learning process.

As science and technology affect our lives in so many ways, it is necessary for students to appreciate and understand the dynamic relationships that exist among science, technology and society. Students need to understand how science is used in technology, and how technology affects the quality of our life and the health of our planet. Students also need to understand the potential value of technology as well as problems

Digitized by the Internet Archive
in 2012 with funding from
University of Alberta Libraries

http://archive.org/details/iopscienceg8g992inte

IOP
SCIENCE
GRADES 8 AND 9

A. PROGRAM RATIONALE AND PHILOSOPHY

RATIONALE

In recognition that the needs of both the individual and society may best be served through school experiences designed to meet student needs and abilities, the *Secondary Education in Alberta* policy statement, June 1985, directs that a program be developed for students who have experienced difficulty learning. This program, beginning in Grade 8, is known as the Integrated Occupational Program (IOP) and articulates with a similar program in the senior high school. The policy states that:

> . . . the goals of secondary schools are to assist students . . . to become aware of the expectations, and be prepared for the opportunities of the workplace—expectations that will be faced as employees or employers; expectations that will be faced as entrepreneurs or volunteers . . . (p. 13)

The policy also states the value of community partnerships in the educational process:

> Opportunities must be provided to involve the community in secondary education programs and to recognize and support learning experiences which take place outside of schools. (p. 8)

In addition, the policy statement directs that:

> The Certificate of Achievement will be awarded to those students who, because of their abilities and needs, have taken the Integrated Occupational Program. The Certificate will recognize their achievement in that program. (p. 23)

The Integrated Occupational Program is designed to enable students to:

- become responsible members of society
- develop entry-level vocational abilities
- recognize the need for lifelong learning.

The Integrated Occupational Science Program, Grades 8 and 9, provides for the development of essential concepts, skills and attitudes in science that will enable students to function successfully in the home, classroom, workplace and community. The program is activity-based, and addresses the need for students to be able to transfer and apply specific scientific concepts and skills to more generalized situations in everyday life and the world of work. This approach is intended to foster an appreciation of science for its usefulness and relevance, and thus motivate students to participate in the learning process.

As science and technology affect our lives in so many ways, it is necessary for students to appreciate and understand the dynamic relationships that exist among science, technology and society. Students need to understand how science is used in technology, and how technology affects the quality of our life and the health of our planet. Students also need to understand the potential value of technology as well as problems

that may arise from its use. Societal issues involving science and technology have been integrated throughout this science program. Community partnerships provide opportunities for students to become involved in the community by way of meaningful activity linked to the science program.

Students are often unaware of strategies they may generate and employ to become more efficient in their cognitive functioning. Evidence supports, however, that students with learning difficulties can perform strategically, if taught to do so. Thinking strategies that foster effective behaviours in planning, organizing and self-monitoring are emphasized throughout the program, and provide students with a systematic and logical approach to dealing with a variety of phenomena encountered in their environment. As students learn to understand and control the outcome of tasks demanded of them, confidence in taking risks and accepting challenges will further their ability to solve problems and make informed decisions in everyday life.

Prescribed content within the Integrated Occupational Science Program, Grades 8 and 9, reflects an emphasis on life skills, and has been determined on the basis of the abilities and needs of students for whom the courses were designed. Nevertheless, the philosophy, goals and directions established in the Integrated Occupational Science Program are consistent with those of other regular program science courses. This continuity will assist students in their transition from a regular program to the IOP, and from the IOP back to a regular program.

PHILOSOPHY

The need to develop programs for exceptional students is based on a fundamental belief about children, as expressed in the government's *Secondary Education in Alberta* policy statement, June 1985, that there should be: " . . . a respect for the unique nature and worth of each individual." (p. 7)

The Integrated Occupational Program rests on a number of additional beliefs and assumptions about the way children learn, the overall potential of these children and their learning needs in relation to societal demands. These beliefs and assumptions have a tremendous impact on program goals, design and implementation.

There are patterns and predictability to children's learning. However, each student's learning preference and pace is unique, reflecting past experiences. The Integrated Occupational Program is designed to address these differences. Though seen as "exceptional" in their learning needs, these children nonetheless fall within the normal range of learning potential; thus, every effort must be made to offer experiences that provide equitable opportunities to participate in all aspects of life. Inherent in the Integrated Occupational Program is an overriding commitment to prepare students for meaningful participation in our democratic society.

The Integrated Occupational Science Program focuses first and foremost on the needs of the learner. As attitude and self-esteem have powerful influences over learning, the program must foster within each student a positive self-concept and a positive attitude toward learning. The concepts, skills and attitudes addressed within the program must:

- provide meaningful and relevant learning experiences
- be appropriate to student ability
- provide for student success
- enable students to understand and function effectively in their personal environment.

Students vary in the ways they receive, process, recall, apply and communicate information. Each student has a preferred way of approaching learning tasks. Instructional planning should include careful assessment of each student's developmental characteristics, knowledge, skills and preferred way of learning. In order to ensure that individual student needs are being met, instructional plans may often need to be adjusted or modified.

Although students are at various stages of cognitive development, most will continue to use concrete operational thinking. Students will depend upon personal experience and personalized content to link new ideas with prior knowledge. As the process of analysis must be based on tangible experience, learning activities should begin at the concrete level. High emphasis

should be placed on experiential learning involving first-hand investigation. An experiential approach will enable students to relate what they are learning to past experience. While concepts and skills cannot be developed in the absence of supporting facts, the knowledge component of science should not be over-emphasized.

Strategies that will assist the learner in progressing from the concrete level of thinking to more abstract thought processes are provided in the program of studies/curriculum guide and corresponding teacher resource manual, available for each IOP course from the Learning Resources Distributing Centre.

An integrated approach suggests the linking together of various scientific skills and strategies into meaningful investigations and activities. Many opportunities are provided for instruction through "thematic study", through the integration of skills "across the curriculum", and through the application of skills to "real-life" situations. This approach adds a motivational dimension to the program, and provides students with direct assistance in transferring specific skills to more generalized situations. Relevancy to daily living and future employment is emphasized throughout the program.

It is intended that the content and process of the Integrated Occupational Science Program provide a student-centred, personal and practical approach to science. A program with these emphases will ensure student success in developing concepts, skills and attitudes that are requisite to responsible participation in the home, classroom, workplace and community.

B. GENERAL LEARNER EXPECTATIONS

The Integrated Occupational Science Program is designed to assist students in developing and maintaining:

- positive and realistic self-images
- constructive relationships with others
- positive attitudes toward science and lifelong learning.

Within the Integrated Occupational Science Program, Grades 8 and 9, *students will be expected to:*

- develop essential concepts, skills and attitudes about science that are required for responsible participation in the home, the school, the workplace and the community
- apply scientific concepts and skills to daily life and occupational situations that are experienced both inside and outside the science classroom
- develop critical and creative thinking skills, and apply these skills to a variety of practical situations through processes of scientific inquiry, problem solving and decision making
- develop appropriate concepts, skills and attitudes in the responsible use of science and technology
- develop communication skills that are used when gathering, interpreting and applying scientific knowledge.

LEARNING DOMAINS

Attitudes

Students will be encouraged to develop attitudes associated with the successful study and practice of science; e.g., curiosity, respect for evidence, inclination to tolerate uncertainty, open-mindedness, critical-mindedness, perseverance, creativity and inventiveness, appreciation for group work, confidence in personal ability, respect for accuracy and precision, concern for safety.

Additionally, students will be encouraged to develop the feelings, opinions, beliefs and appreciations that individuals have formed as a result of interacting with various aspects of the scientific enterprise; e.g., a positive attitude toward mathematical and scientific process skills, need for problem-solving skills, respect for historical development, appreciation of ethical dilemmas that may arise from the application of scientific and/or technological developments, sensitivity to the living and non-living environment.

Skills

The skills identified below serve to guide the design of learning experiences and the construction of assessment schemes. Skills are not intended to be developed separately or sequentially, but rather, concurrently with attitude and concept components.

Students will be expected to demonstrate an ability to:

- distinguish between relevant and irrelevant information; e.g., define problems/identify issues, set goals by establishing purpose and direction, formulate questions to guide research/inquiry, identify variables
- gather information or data; e.g., use an experimental design or research plan, make qualitative and quantitative observations, effectively use apparatus and equipment
- arrange or structure information so it can be readily understood or presented; e.g., classify, order and identify patterns/trends, draw charts/graphs/diagrams, make estimates, create models/analogies
- analyze data or information; e.g., identify main ideas/attributes/components, identify patterns and relationships, identify cause and effect

UNIVERSITY LIBRARY
UNIVERSITY OF ALBERTA

- make connections among new ideas and prior knowledge, and generate information beyond that which is given; e.g., explain and elaborate; predict and hypothesize; infer and generalize from the data; design experiments or devise a plan for research; test and troubleshoot; identify further problems, questions and issues to be investigated

- integrate new information with prior knowledge; e.g., summarize and communicate findings, develop consensus within a group, make a decision or develop a conclusion/solution

- assess the logic and quality of ideas and information; e.g., consider consequences, consider adequacy of data, assess a design or approach taken to inquiry, problem solving or decision making, assess the achievement of goals set.

Concepts

The concepts component includes major ideas and understandings in science that enable students to interpret objects and events in their natural environment. Students will be expected to develop an operational understanding of concepts listed in the paragraphs that follow (see Program Emphases: Nature of Science; Science and Technology; Science, Technology and Societal Issues).

PROGRAM EMPHASES

Nature of Science

An emphasis on the nature of science and the inquiry process will enable students to understand the ways in which scientific knowledge is gathered, as well as use this knowledge in conducting investigations of their own.

Students will be expected to demonstrate an understanding that:

- science is a disciplined way to develop explanations for the events and objects of the natural world

- science is comprised not only of an accumulated body of knowledge, but also of the processes by which that knowledge is developed

- empirical evidence plays an important role in the development of scientific knowledge

- physical laws and conceptual inventions that are theoretical and tentative in nature attempt to explain the universe

- proposed theories may be supported, modified or falsified by experimental evidence

- scientific knowledge is cumulative and subject to change.

Science and Technology

An emphasis on science and technology will enable students to understand the interaction between science and technology, and how science and technology may contribute to the solution of practical problems in everyday life.

Students will be expected to demonstrate an understanding that:

- technology facilitates the solving of practical problems

- technological development includes both products and processes

- the functioning of products and processes may be explained using scientific knowledge

- science can be used to advance technology, and technology can be used to advance science

- existing and emerging technologies have application in many everyday and work-related situations

- scientific knowledge and technology have limitations.

Science, Technology and Societal Issues

An emphasis on science, technology and societal issues will enable students to understand interactions that occur among science, technology and society, and how science and technology influence and are influenced by societal issues.

Students will be expected to demonstrate an understanding that:

- science and technology have impact on our lifestyle, occupational choice, environment and welfare
- technological products and processes develop in response to societal needs and wants
- economic, political and ethical perspectives often interact with science and technology and exert significant influence on each
- often the products of science and technology are accepted and used by society before the full extent of benefits/problems resulting from their use can be fully known
- scientific, technological and societal aspects of an issue help to inform the societal decision-making process
- compromises are often needed in order to arrive at workable solutions involving science and technology in society.

Specific Learner Expectations

Specific learner expectations (learning objectives) have been identified for the Integrated Occupational Science Program in the Statement of Content, which follows.

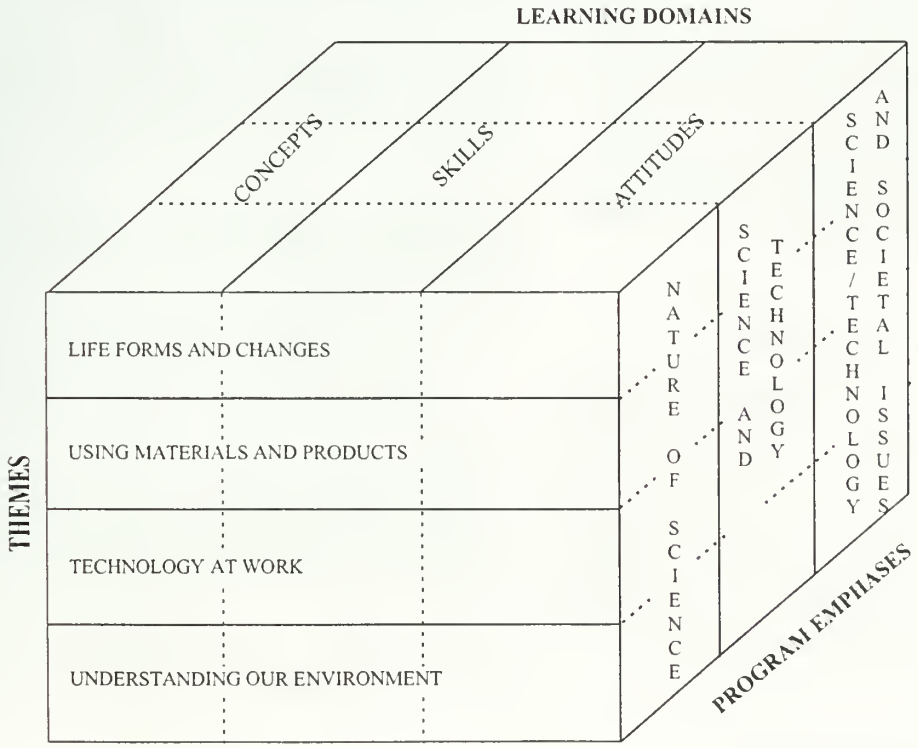
C. STATEMENT OF CONTENT

PROGRAM FRAMEWORK

The framework for the Integrated Occupational Science Program, depicted in the model below, illustrates an integration of program dimensions. Three dimensions that provide a basis for program planning are represented in the model.

- The LEARNING DOMAINS, represented on the upper face of the model, provide a structure for the science program and include the concepts, skills and attitudes that students will be expected to develop. Prescribed content within each of the learning domains has been selected on the basis of frequent task demands placed on students in daily life and work-related situations. The learning domains provide a foundation upon which more difficult concepts and skills may be built in the senior high school years.
- The PROGRAM EMPHASES, represented on the right face of the model, take into account both the content and intent of science education, and foster the development of knowledge and behaviours that will enable students to interpret and process information in their environment relative to the demands of everyday life. Learning activities that foster the development of knowledge and behaviours related to each program emphasis should be provided in concert with activities designed to develop prescribed content within the learning domains.
- The THEMES provide situational and concrete learning experiences where concepts, skills and attitudes are linked with appropriate program emphases. The themes are placed on the front face of the model to highlight their importance in planning an integrated program. Four themes that address prescribed components within the Integrated Occupational Science Program are provided in the teacher resource manual, available from the Learning Resources Distributing Centre.

INTEGRATED OCCUPATIONAL SCIENCE PROGRAM, GRADES 8 AND 9



IOP Science C.1 (Grades 8 and 9) (Interim 1992)

TIME ALLOCATION

The Integrated Occupational Science Program, Grades 8 and 9, must be offered through a minimum of 100 hours of instruction at each grade level. Schools are encouraged to offer these courses through a time structure that exceeds the 100-hour minimum requirement, if this will help to ensure student success.

COMMUNITY PARTNERSHIPS

Students need to recognize the relevance of scientific knowledge in daily life experiences within the home, community and work environments. Within this context, students will be expected to demonstrate competencies that will enable them to:

- apply scientific concepts and skills to practical situations
- set goals, solve problems and make informed decisions
- begin to prepare for a chosen occupation or career.

Community partnerships are community-based learning experiences that will foster an appreciation of science for its usefulness and relevance, and will assist students to transfer specific concepts and skills to more generalized situations in everyday life and the world of work. Community partnerships include in-school visits, demonstrations, talks, etc., given by community members; and teacher/student observations, job shadowing, work study and work experience activities within the community.

CURRICULAR INTEGRATION

Teachers have traditionally tended to integrate concepts, skills and attitudes from other subject areas into their teaching specialty; however, this tendency has generally been incidental rather than by curricular and instructional design. In contrast, the Integrated Occupational Program is designed specifically to integrate related concepts, skills and attitudes across the curriculum. In addition, teachers in the program are encouraged to adopt integrated planning and teaching strategies.

Suggestions for relating prescribed content within the science program to daily life skills and applications in other subject areas across the curriculum are provided in the program of studies/curriculum guide and corresponding teacher resource manual.

REQUIRED AND ELECTIVE COMPONENTS

The required component of the Integrated Occupational Science Program, Grades 8 and 9, includes the concepts, skills and attitudes that all students must acquire. The learner expectations identified within this document comprise the required component of the science program.

The required component of this science program has been integrated into four themes at each grade level:

- Life Forms and Changes
- Using Materials and Products
- Technology at Work
- Understanding Our Environment.

These themes are developed in the teacher resource manual and include a variety of student activities intended to provide suggestions, models and strategies. Although using these themes will ensure coverage of the required component, teachers are encouraged to add, delete and alter activities to meet the abilities, needs and interests of students.

The elective component of the Integrated Occupational Science Program, Grades 8 and 9, permits the teacher to:

- extend or expand upon topics, thus embedding additional concepts, skills and attitudes considered appropriate to student interest and need
- enrich the program by introducing new concepts and activities considered relevant to the student and the local community
- remediate or reinforce concepts, skills and attitudes within the required component.

Students' abilities, interests and needs will largely determine how the elective component will be used. Teachers should assess student performance

on an ongoing basis, and use the elective component of each course to provide individual students with remedial and/or enrichment activities.

Instructional time for the Integrated Occupational Science Program, Grades 8 and 9, should be apportioned:

- 80% Required
- 20% Elective.

PROGRAM SEQUENCES AND TRANSFER POINTS

Students may enter the Integrated Occupational Program at either the Grade 8 or Grade 9 levels. Criteria for determining student eligibility for the Integrated Occupational Program are provided in the current *Guide to Education: ECS to Grade 12 Handbook*.

After one or two years in IOP at the junior high school level, students may transfer to regular programs, or progress in the Integrated Occupational Program at the senior high school level. Decisions regarding course sequences and transfer points throughout junior high school should reflect the achievements, needs and interests of individual students.

Teachers are encouraged to assist students in planning their high school programs. All students should become familiar with the credit requirements for graduation from senior high school, and obligatory courses for the Certificate of Achievement and/or diplomas. Information regarding high school programs and graduation requirements is outlined in the current *Guide to Education: ECS to Grade 12 Handbook*.

SPECIFIC LEARNER EXPECTATIONS

Specific learner expectations for the Integrated Occupational Science Program, Grades 8 and 9, are provided on the pages that follow. Learner expectations have been clustered into four themes that provide situational and concrete learning experiences at each level.

The specific learner expectations that follow comprise the required component of each science course. Prescribed concepts, skills and attitudes should be appropriately clustered and applied to progressively difficult and/or age-appropriate situations as students advance through junior high school. Teachers are encouraged to organize for instruction in ways that are consistent with the abilities, interests and needs of students, using relevant sections of the program of studies/ curriculum guide and teacher resource manual, locally developed themes or a combination of approaches.

Prescribed content for the Integrated Occupational Science Program is developmental through Grades 8 and 9. The Integrated Occupational Science Program, Grade 9, provides opportunities for students to reinforce and refine attitudes and skills developed in Grade 8 through more extensive applications, and prescribes new concepts within each of four thematic areas of study. In cases where specific learner expectations are repeated in Grades 8 and 9, it is expected that teachers will help students to increase in proficiency from grade to grade.

LIFE FORMS AND CHANGES

Grade 8 Overview

Growing Plants

By conducting a series of controlled experiments, *students will develop* knowledge of plant structures and factors that contribute to the nourishment and care of plants. Instruction should focus attention on technologies designed to enhance plant growth and yield, and ways in which human actions have affected the variety, distribution and growth of plants found in the local environment.

A major emphasis of this theme is on **Science and Technology**. Opportunities are also provided to support learning regarding the **Nature of Science**, and regarding **Science, Technology and Societal Issues**.

Grade 9 Overview

Diversity in Living Things

Students will develop an understanding of the diversity that exists among living organisms in the local environment. Investigations focus attention on how living organisms interact, adapt, compete and change. *Students will investigate* plant and animal adaptations, and use classification systems to organize and structure the diversity observed in living organisms.

A major emphasis of this theme is on the **Nature of Science**. Opportunities are also provided to support learning regarding **Science and Technology**, and regarding **Science, Technology and Societal Issues**.

Specific Learner Expectations

Grade 8

Attitudes
The student will be expected to:

- develop an awareness of the role of plants in sustaining human life
- appreciate that the distribution and growth of plants is very much affected by environmental modifications and human interventions
- develop an awareness that agricultural and domestic varieties of plants are usually the products of intensive breeding programs
- demonstrate, through discussion and personal action, a respect for living things
- display confidence in personal ability to nurture plants.

Grade 9

Attitudes
The student will be expected to:

- develop an awareness and appreciation of the interrelatedness of life forms
- develop a sensitivity for the delicate balance among living things and their environment
- appreciate the diversity of life forms, and the effects of human actions in increasing or decreasing the diversity of living things
- demonstrate, through discussion and personal action, a respect for living things and a commitment to protecting the environment
- display confidence in personal ability to provide care for living organisms.

Grade 8	Grade 9
Skills *The student will be expected to demonstrate an ability to:*	**Skills** *The student will be expected to demonstrate an ability to:*
• identify problems and formulate questions related to the growth of plants	• identify patterns and discrepant events among living things, and formulate questions regarding relationships among specific organisms
• use appropriate apparatus and research methods to gather information regarding: – the cellular structure of plants – major plant structures, including the leaf, stem, root and flower – the life processes of plants, including osmosis, conduction, transpiration, photosynthesis and reproduction	• use appropriate techniques and tools of observation to gather information regarding: – the structural features of plants and animals – similarities and differences in the overall structure of particular groups of plants and animals – the distribution of plants and animals within an environment
• make qualitative and quantitative observations in order to: – describe the growth of a plant – compare the growth patterns and growth requirements of two or more plants	• perform a plant and animal census within a given plot in the local community, and formulate hypotheses regarding: – the adaptive value of particular structures and behaviours in plants and animals – environmental conditions that affect the survival and distribution of particular species – relationships and dependencies among particular living things
• use an experimental design and conduct investigations that: – monitor the effect of variations in growth conditions on plant development – test the effectiveness of alternative methods of plant propagation	• plan and conduct investigations that examine: – adaptive responses in plants and animals – the developmental stages/life cycles of particular plant and animal groups
• prepare and interpret charts and diagrams that indicate the results of selective breeding and cross-breeding in plants	• construct and use a dichotomous key; classify familiar organisms by major scientific groups; e.g., kingdom, phylum
• apply knowledge of plant structure and growth requirements in new situations, predicting and hypothesizing: – the response of plant structures to varying environmental conditions, diseases and pests – possible causes of ill health and growth problems in plants	• make generalizations about the adaptations and interactions of organisms, inferring: – evidence of relationships among living things – risk of extinction based on characteristics of particular living things and knowledge of changing environmental conditions
• carry out a plan for providing care for plants and troubleshooting plant growth problems.	• develop and apply a strategy for providing care for a living organism.

Grade 8

Concepts

The student will be expected to demonstrate an understanding that:

- life processes of plants are carried out by specific plant structures:
  - identify and describe major root, stem and leaf structures of vascular plants
  - describe and interpret life processes of plants; i.e., osmosis, transpiration, conduction, photosynthesis
- certain environmental conditions are required for germination and plant growth:
  - identify essential natural requirements for plant growth
  - describe the functional value of soil components relative to plant needs
  - compare the growth patterns of two or more plants in response to variations in growth conditions
- technology can be used to create controlled environments that maximize plant growth:
  - identify practices intended to enhance soil conditions; e.g., aeration, liming
  - identify practices that involve the application of fertilizers and growth supplements
  - describe the growth of plants in hydroponic solution
- plant propagation may be carried out through vegetative processes as well as by the use of seeds:
  - identify flower parts and their function
  - describe the propagation of plants by vegetative techniques; e.g., leaf or stem cuttings
- specialized varieties of plants are developed through programs of controlled breeding:
  - identify desirable characteristics of plants
  - infer the adaptive and economic value of different plant characteristics
  - describe the use of selective breeding in the production of new plant varieties
- plants react to changing environmental conditions and to the actions of various pests:
  - identify symptoms of plant stress caused by imbalance in essential growth requirements, or by pests and diseases
  - describe the relative merits of biological and chemical alternatives for pest control.

Grade 9

Concepts

The student will be expected to demonstrate an understanding that:

- living things show a diversity of structural and behavioural adaptations:
  - identify examples of variation in size, shape and physical structure of organisms
  - identify animal structures that play a role in locomotion, securing of food and avoidance of predators
  - identify plant structures that serve needs for obtaining and distributing nutrients, reproduction and protection
  - identify and describe examples of mutual dependency and mimicry in plants and/or animals
- diversity in living organisms occurs as a result of the adaptive response of organisms to their environment:
  - infer environmental conditions for which particular structures are adaptive
  - identify examples of adaptation to a single food source or to a narrow range of food sources
- the concept of natural selection provides a basis for interpreting the evolution and extinction of species:
  - give examples where the features of a particular species have changed over generations through the process of natural selection
  - give examples where living organisms have become extinct through lack of diversity, adaptation and/or specialization
- classification of living things is based on similarities and differences among organisms:
  - describe the Linnaean classification system, and compare it to other systems of classification
  - identify major taxonomic levels used in scientific classification
  - infer the relatedness of species on the basis of their scientific classification
- individual living things can be interpreted as members of groups of organisms that share common features:
  - identify the structural characteristics of major groups of living things
  - describe life cycles that illustrate complete and incomplete metamorphosis.

USING MATERIALS AND PRODUCTS

Grade 8 Overview	Grade 9 Overview
Working with Solutions	Using Chemical Products
Students will investigate the properties of solutions and their application in familiar household and personal care products. *Students will be expected to* develop a strategy and respect for the safe handling of laboratory equipment and supplies, and become aware of appropriate procedures for handling potentially hazardous substances found at home and in the workplace.	*Students will investigate* the properties and reaction patterns of chemical products used at home and in the workplace. Particular attention is given to the chemistry of acids and bases. *Students will practise* previously developed strategies for the safe handling of laboratory equipment and supplies, and apply appropriate procedures for handling potentially hazardous materials.
A major emphasis of this theme is on the **Nature of Science**. Opportunities are also provided to support learning regarding **Science and Technology**, and regarding **Science, Technology and Societal Issues**.	A major emphasis of this theme is on the **Nature of Science**. Opportunities are also provided to support learning regarding **Science and Technology**, and regarding **Science, Technology and Societal Issues**.

Specific Learner Expectations

Grade 8	Grade 9
Attitudes *The student will be expected to:*	**Attitudes** *The student will be expected to:*
• appreciate the extent to which solutions are part of both natural and manufactured products	• appreciate that all materials have a chemical composition and react according to predictable patterns
• appreciate that science and technology have contributed to the development of a variety of household products	
• develop an awareness of solution chemistry as a practical science	• develop an awareness of the usefulness of inquiry skills in providing explanations for a variety of chemical reactions
• display a concern for personal safety and the safety of others when handling laboratory equipment and supplies	
• develop an awareness of the potential hazards of chemical substances found at home and in the workplace.	• adopt a prudent approach to the handling of chemical products, especially those that are unfamiliar to the user.

Grade 8	Grade 9
Skills *The student will be expected to demonstrate an ability to:*	**Skills** *The student will be expected to demonstrate an ability to:*
• practise safe procedures for handling and storing potentially hazardous materials: – interpret hazardous product symbols and read product ingredient labels – follow instructions for safe use, handling and storing – predict the potential hazards of mixing certain products – identify recovery techniques for errors in handling chemical substances	
• select and use a range of measuring instruments to quantify observations regarding the physical properties of solutions and mixtures	• select and use more complex measuring instruments with an appropriate degree of accuracy to quantify observations regarding materials and products
• accurately record qualitative and quantitative observations regarding solutions and mixtures, in narrative and chart form	• use charts, graphs and other methods to display data gathered about materials and products
• classify familiar mixtures as solutions and non-solutions, and familiar materials according to their solubility	• classify changes in materials as chemical or physical, and classify common household substances according to chemical composition
• follow written and verbal instructions, and use laboratory equipment in appropriate ways when preparing solutions and separating mixtures into their components	• use experience and knowledge to make testable hypotheses regarding: – physical and chemical properties of materials – the solubility of given substances – the identification and behaviour of acids, bases and other household substances
• identify independent and dependent variables relevant to an investigation, and hypothesize relationships between variables	• identify and manipulate relevant independent and dependent variables within the context of an experimental procedure
• conduct investigations that examine: – factors affecting solubility – factors affecting the rate of dissolving – the affect of solution strength on freezing/ boiling point	• design and conduct collaborative investigations that examine: – the reaction patterns of acids and bases – oxidation reactions – factors influencing the reaction rate of chemical substances
• apply techniques for the separation of mixtures into their components, and the recovery of solutes from solutions.	• suggest alternatives and develop practical methods of inhibiting corrosion of household materials: – identify a problem related to corrosion – gather information/propose alternatives – select an alternative/build a design – test/evaluate/apply the design.

Grade 8

Concepts

The student will be expected to demonstrate an understanding that:

- solutions can be found in many forms, both in natural and human-made materials:
  - distinguish between solutions and non-solutions
  - identify examples of solutions in natural and human-made materials
- solutions can be described in terms of composition, concentration and physical properties:
  - identify solute and solvent in familiar household solutions
  - distinguish between the properties of household solutions that are water based, and those that contain solvents other than water
  - explain how the concentration of a solution affects the properties of that solution; e.g., freezing point, boiling point
  - describe the physical properties of familiar household solutions
- the solubility of materials and the rate at which materials dissolve are found to vary with the conditions of solution:
  - explain that the amount of a solute that will dissolve in a given solution generally has an upper limit; i.e., saturation point
  - distinguish among diluted, concentrated and saturated solutions
  - identify factors/conditions that affect the solubility of materials; i.e., temperature, choice of solvent
  - identify factors/conditions that affect rate of dissolving; i.e., temperature, particle size, mechanical movement
- knowledge of solubility can be applied to the separation of materials:
  - describe procedures/techniques used to separate mixtures into their components; i.e., settling, filtration, evaporation, distillation, crystallization
  - describe procedures/techniques used to recover solutes from a solution; e.g., evaporation, distillation, crystallization.

Grade 9

Concepts

The student will be expected to demonstrate an understanding that:

- common household substances have physical and chemical properties:
  - distinguish between chemical and physical properties of common household substances
  - identify chemical and physical changes in household substances
  - classify household chemicals according to their hazardous properties and appropriate conditions for storage
- acidity (pH) is a measurable characteristic of liquid solutions:
  - describe the natural properties of acids and bases
  - explain hazards and safe procedures related to the use of acids and bases
  - identify pH through the use of various indicators
  - identify acid and base substances used in the home
  - explain the usefulness and potential hazards of acid–base reactions used in the home
- chemical substances react according to predictable patterns, and rates of reaction vary with the conditions of the reacting materials:
  - predict and describe the affects of temperature change, concentration of materials and size of particles on rate of reaction
  - predict and describe potential hazards of chemical reactions among particular household substances under varying conditions
- oxidation and corrosion reactions can be controlled by chemical and physical means:
  - identify familiar examples of oxidation and corrosion
  - explain the usefulness of, and problems associated with, oxidation reactions
  - describe physical and chemical means of preventing/controlling oxidation and corrosion.

TECHNOLOGY AT WORK

Grade 8 Overview	Grade 9 Overview
Using Energy and Machines	Electrical Systems in the Home
Technology makes use of energy sources in familiar mechanical systems found at home and in the workplace. *Students will develop* an understanding of scientific principles governing the operation of simple machines and more complex mechanical systems, and gain experience in the construction and repair of simple mechanical technologies.	Interrelated forms of magnetism and electricity are used in a variety of household technologies. *Students will develop* an understanding of the basic principles of electromagnetism, and their application in familiar electromechanical devices. Instruction should enable students to become aware of the inherent hazards of electricity, and gain experience in the construction and repair of simple electrical systems.
A major emphasis of this theme is on **Science and Technology**. Opportunities are also provided to support learning regarding the **Nature of Science**, and regarding **Science, Technology and Societal Issues**.	A major emphasis of this theme is on **Science and Technology**. Opportunities are also provided to support learning regarding the **Nature of Science**, and regarding **Science, Technology and Societal Issues**.

Specific Learner Expectations

Grade 8	Grade 9
Attitudes *The student will be expected to:*	**Attitudes** *The student will be expected to:*
• demonstrate an awareness that practical problems can often be solved in multiple ways	• demonstrate confidence in personal ability to solve practical problems
• appreciate the usefulness of technological problem-solving skills in practical situations	
• develop an awareness of the relationship between science and familiar technologies	• develop an awareness of relationships among science, technology and society
• display a concern for safety when operating mechanical devices and systems	• display safe attitudes regarding the use of electrical technologies
• display responsible attitudes toward personal consumption of energy.	• display responsible attitudes toward energy consumption as it relates to personal and global needs.

Grade 8	Grade 9
Skills *The student will be expected to demonstrate an ability to:*	**Skills** *The student will be expected to demonstrate an ability to:*
• observe, at first hand, the operation of familiar mechanical devices, identifying component parts and asking relevant questions	• analyze familiar electromagnetic devices, identifying subsystems, interpreting relationships among component parts, and tracing energy flow
• formulate hypotheses regarding: – science principles that are used in the operation of simple machines – alternative designs for a mechanical system – ways to increase the efficiency of a simple mechanical system	• formulate testable hypotheses regarding: – science principles that are used in the operation of electromagnetic devices – alternative designs for an electromagnetic system – problems in the design or construction of a circuit
• carry out investigations with levers, inclined planes, pulleys and pulley systems, and record findings in charts, drawings and other appropriate forms	• plan and safely conduct collaborative investigations that demonstrate basic science principles associated with static electricity, magnetism, and the operation of simple electrical circuits and electromagnetic systems
• prepare drawings of energy chains that trace forms of energy used in machines back to their original sources	• construct and interpret systems diagrams that represent simple series and parallel circuits
• perform simple calculations as required in order to determine: – mechanical advantage – work input and output – efficiency ratings	• perform series of calculations as required in order to determine: – electrical energy consumed in performing specific household tasks – energy costs related to household tasks that are performed
• apply problem-solving strategies in order to correct practical problems in a technological device or system containing relatively few components: – identify the source of the problem; e.g., excessive friction, the fit of moving parts, short circuits – consider alternative approaches to a solution – evaluate alternatives and make necessary repairs – evaluate the procedure and process used	
• follow written and diagrammatic instructions in order to construct a simple mechanical device intended to perform a given function; suggest changes in design that would improve safety, ease of operation and/or overall efficiency of the device.	• design and construct a simple electrical device intended to perform a given function, and following proper safety practices; test the device and identify modifications that would improve safety, ease of operation and/or overall efficiency of the device.

Grade 8

Concepts

The student will be expected to demonstrate an understanding that:

- mechanical devices are systems made up of subsystems and components:
  - identify components of a simple mechanical device
  - identify parts of a mechanical device that work together as a subsystem
- mechanical systems are designed to transfer energy and change the direction, speed and/or magnitude of force:
  - explain the relationship among force, motion, work and energy
  - identify the functions of some common mechanical devices
  - explain the contribution of subsystems to the overall functioning of a device
  - identify components that operate as simple machines, and the principles governing their operation
- energy flow and transmission of power occur among different parts of a system:
  - identify sources of energy used to power familiar mechanical devices
  - describe energy flow and power linkages within a mechanical system
- mechanical systems convert energy from one form to another:
  - identify examples of energy conversion in familiar mechanical devices
  - explain modifications that will enable a device to use more than one form of energy input
- the efficiency of a mechanical device can often be improved through changes in design:
  - explain how the forces of friction and gravity affect work that is accomplished
  - identify design changes that could improve safety, ease of operation and overall efficiency
  - interpret information on energy efficiency of different devices or products
- non-renewable sources of energy are being consumed at rapid rates:
  - distinguish between renewable and non-renewable sources of energy
  - identify the impact of inefficient energy use on environments and resources.

Grade 9

Concepts

The student will be expected to demonstrate an understanding that:

- there are dangers inherent in the use of electricity:
  - distinguish between devices that might be safely used in an investigation and those that would not be appropriate
  - recognize dangerous procedures and situations
  - recognize equipment that is in an unsafe condition for use
- electromagnetism provides a means for the conversion of mechanical energy to electrical:
  - describe the interrelationship between magnetism and an electric current
  - interpret and describe the operation of simple generators and electric motors
- electrical devices are based on circuits:
  - construct and explain applications of series and parallel circuits
  - describe the operation of switches, grounding devices, fuses and circuit breakers
  - construct and interpret circuit diagrams
  - identify and repair short circuits
- electrical resistance can be used to control the flow of electricity in a circuit or to produce heat and light:
  - describe the effect of resistance on electron flow in a simple circuit
  - explain applications of principles of resistance in the selection of conductors
  - explain applications of electrical resistance in devices that produce heat and light
- electromechanical systems can be designed to perform simple or complex functions:
  - identify systems and subsystems within familiar electromechanical devices
  - relate principles of magnetism and electricity to the operation of familiar electromechanical devices
- personal consumption of electrical energy can be monitored:
  - identify strategies for monitoring personal consumption of electrical energy
  - determine energy costs related to performing specific tasks.

UNDERSTANDING OUR ENVIRONMENT

Grade 8 Overview	Grade 9 Overview
Interacting with Our Environment	Monitoring the Local Environment
This theme focuses attention on the study of living things in relation to their environment. *Students will examine* the interactions of familiar organisms with other living and non-living elements in the environment. Instruction should provide opportunities for students to develop an understanding of the impact of human activity on the local environment.	A healthy environment is the challenge of today and the hope of tomorrow. Human interventions within the environment have both short-term and long-term effects on our quality of life. Instruction within this theme enables students to investigate local environment issues, and develop action plans for dealing with these issues.
A major emphasis of this theme is on **Science, Technology and Societal Issues**. Opportunities are also provided to support learning regarding the **Nature of Science**, and regarding **Science and Technology**.	A major emphasis of this theme is on **Science, Technology and Societal Issues**. Opportunities are also provided to support learning regarding the **Nature of Science**, and regarding **Science and Technology**.

Specific Learner Expectations

Grade 8	Grade 9
Attitudes *The student will be expected to:*	**Attitudes** *The student will be expected to:*
• develop an awareness of the impact of human activity on environmental quality, and the impact of environmental factors on living things	• develop sensitivity to the delicate balance between living organisms and their environment
• develop an awareness that environmental issues often involve relationships among science, technology and society	
• appreciate that the products of science and technology are often used by society before the full extent of benefits/problems resulting from their use are fully known	
• show concern and commitment for maintaining natural life-support systems	• appreciate the role of scientific knowledge in assisting individuals to make informed choices regarding environmental issues
• develop an awareness of the need to monitor and manage the environment.	• demonstrate a commitment, through discussion and personal action, to protecting and improving the environment.

Grade 8	Grade 9
Skills *The student will be expected to demonstrate an ability to:*	**Skills** *The student will be expected to demonstrate an ability to:*
• identify and observe living things in the immediate environment, asking questions about: – the distribution patterns of plants and animals – interrelationships and dependencies between plants and animals	• observe and quantify abiotic conditions in the environment that are modified as a result of human activity; e.g., temperature, moisture, light, pH level
• propose ideas regarding: – relationships among specific living things – the effects of given abiotic conditions on the distribution of plants and animals	• formulate hypotheses regarding the impact of particular human practices and interventions on water, air and soil quality
• use a research plan, and conduct investigations of living things within a given study plot: – perform a plant and animal census – gather data regrading biotic and abiotic conditions and relationships – interpret data and record in narrative or chart form	• plan and conduct collaborative investigations that monitor local pollution factors and environmental quality: – identify and control relevant variables – gather qualitative and quantitative data regarding indicators of water, air and soil quality – interpret data and apply to acceptable standards
• draw conclusions and make inferences regarding interrelationships, dependencies and energy flow among living things	• draw conclusions and make predictions regarding the short-term and long-term effects of human interventions on the environment
• communicate the results of investigation: – make generalized statements based on findings – construct diagrams or models of food chains and food webs – classify living things within a local study plot	• communicate the results of investigation: – display findings through the use of charts and graphs – prepare and present a report
• develop and apply a strategy for making informed choices regarding actions that have potential impact on the environment: – identify an issue/concern related to use of the environment – gather background information about the issue through observation, interview and/or research – identify alternative courses of action, and personal, social and environmental perspectives related to each alternative – predict the consequences of alternative courses of action – reflect and decide upon an appropriate course of action, considering alternatives, perspectives and building consensus – evaluate the effects of actions taken, and consider improvements to the decision-making process.	

Grade 8

Concepts

The student will be expected to demonstrate an understanding that:

- environments can be described in terms of abiotic conditions:
  - identify, observe and measure abiotic factors in environments
  - classify and describe an environment in terms of biotic factors
  - describe the effect of abiotic factors on living organisms
- the interdependence of living things is evident in the interactions of organisms with each other and with their environments:
  - identify interactions that occur among living organisms in the local environment
  - interpret distribution patterns of living things within their environments
  - interpret plant and animal behaviours that indicate dependencies for food or for other needs
  - recognize examples of parasitism, commensalism and mutualism
- food chain and food web relationships explain energy flow among living organisms:
  - describe the Sun as the source of all energy
  - infer food chain and food web relationships within an ecosystem
  - explain energy flow within an ecosystem
  - classify animals within an ecosystem as producers, consumers or decomposers
- human actions have impact on the survival of particular plants and animals:
  - identify intended/unintended consequences of human actions on local environments
  - predict consequences of adding/removing living things from an environment
  - predict the impact of pesticides, herbicides or other pollutants on an environment
- individuals and society have the ability to protect and manage the environment:
  - identify local policies and controls designed to protect the environment
  - identify ways in which individuals can initiate and/or support social action intended to protect the environment.

Grade 9

Concepts

The student will be expected to demonstrate an understanding that:

- human actions modify environments through changes to living things, water, air and land:
  - describe examples of direct changes to environments that occur as a result of resource extraction, agriculture and/or human settlement
  - describe examples of changes to environments that occur as indirect consequences of human actions
- a variety of biotic and abiotic factors are used as indicators of environmental quality:
  - identify abiotic factors in an environment that might affect the health and distribution of living things
  - interpret the quality of an environment in terms of the variety of life forms it supports
  - describe effects of the removal of selected species on other species in an environment
  - identify indicators of water, soil and air quality
- pollutants are materials added to environments that negatively affect the quality of that environment:
  - identify household, municipal and industrial materials that comprise major sources of pollution in the local area
  - identify components of waste materials that have known negative effects
  - identify mechanisms by which pollutants are added to the environment
- materials added to the environment remain until moved or converted to another form:
  - distinguish between wastes that are biodegradable and non-biodegradable
  - describe the effect of ground/surface water on the distribution of pollutants describe techniques used locally for the disposal of a waste substance
- decisions and actions at a personal level affect environmental quality:
  - identify personal actions that can help to assure that disposal of wastes occurs with minimal environmental impact
  - identify personal actions that can contribute to responsible societal action regarding an environmental issue.